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(54) SOLID ELECTROLYTIC CAPACITOR AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a solid electrolytic capacitor whose maximum working temperature is at least 105°C, and its manufacturing method.
SOLUTION: An anode foil and a cathode foil on the surfaces of which oxide coating film layers are formed are wound via a separator, and a capacitor element is formed. The capacitor element is impregnated with an EDT(ethylene dioxithiophene) monomer and further with butanol solution of ferric paratoluene sulfonic acid as oxidizing agent solution and heated. A solid electrolyte layer composed of PEDT(polyethylene dioxithiophene) is formed. After the capacitor element is dried, silicon resin is stuck on the surface of the capacitor element and thermoset. The outer periphery of the capacitor element is covered with sheath resin. Electrode lead-out means are inserted in penetrating holes formed in a sealing rubber, the capacitor element is installed in a cylindrical close-end sheathing case, an aperture part of the sheathing case is sealed with sealing rubber, and a solid state electrolytic capacitor is constituted.

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CLAIMS

[Claim(s)]
[Claim 1] The solid electrolytic capacitor characterized by forming in the front face of a capacitor element the layer which consists of a silicon system sealing agent after drying said capacitor element in the solid electrolytic capacitor equipped with the capacitor element in which the solid electrolyte layer which consists of polyethylene dioxythiophene was formed between two-poles electrode foils, while winding the two-poles electrode foil to which the electrode drawer means was connected through the separator.
[Claim 2] The solid electrolytic capacitor according to claim 1 with which said silicon system sealing agent is characterized by being silicon resin or a silicone oil.
[Claim 3] The solid electrolytic capacitor according to claim 1 or 2 with which drying temperature of said capacitor element is characterized by being 15-120 degrees C.
[Claim 4] The solid electrolytic capacitor according to claim 1 to 3 with which the drying time of said capacitor element is characterized by being 5 - 30 minutes.
[Claim 5] Wind the two-poles electrode foil to which the electrode drawer means was connected through a separator, and a capacitor element is formed. Sink ethylene dioxythiophene into this capacitor element, further, sink in, heat an oxidizer solution, and a solid electrolyte layer is formed. After drying this capacitor element, form in the front face of a capacitor element the layer which consists of a silicon system sealing agent, insert into the through tube in which said electrode drawer means was formed by obturation rubber, and a cylinder-like-object-with-base-like sheathing case is equipped with this capacitor element. The manufacture approach of the solid electrolytic capacitor characterized by obturating opening of said sheathing case with said obturation rubber.
[Claim 6] The manufacture approach of a solid electrolytic capacitor according to claim 5 that said silicon system sealing agent is characterized by being silicon resin or a silicone oil.
[Claim 7] The manufacture approach of a solid electrolytic capacitor according to claim 5 or 6 that drying temperature of said capacitor element is characterized by being 15-120 degrees C.
[Claim 8] The manufacture approach of a solid electrolytic capacitor according to claim 5 to 7 that the drying time of said capacitor element is characterized by being 5 - 30 minutes.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a solid electrolytic capacitor and its manufacture approach, and relates to the solid electrolytic capacitor which improved in order to aim at improvement in an elevated-temperature life property especially, and its manufacture approach.
[0002]
[Description of the Prior Art] Generally the electrolytic capacitor using the metal which has valve action, such as a tantalum or aluminum, is widely used from the ability of a small and big capacity to be obtained by making the valve action metal as an anode plate side counterelectrode into the configuration of a sintered compact or an etching foil, and surface-expansion-izing a dielectric. In addition to being small, large capacity, and low equivalent series resistance, itis [chip-] easy toize especially the solid electrolytic capacitor that used the solid electrolyte for the electrolyte, and since it is equipped with special features, such as being suitable for the surface mount, it is indispensable to the miniaturization of electronic equipment, advanced features, and low cost-ization.
[0003] In this kind of solid electrolytic capacitor, as small and a mass application, a separator is made to intervene, generally, the anode plate foil and cathode foil which consist of valve action metals, such as aluminum, are wound, a capacitor element is formed, the electrolytic solution for a drive is sunk into this capacitor element, and it has the structure which contained and sealed the capacitor element in metal cases, such as aluminum, or the case made of synthetic resin. In addition, as an anode material, a tantalum, niobium, titanium, etc. are used by making aluminum into the start, and an anode material and a metal of the same kind are used for a cathode material.
[0004] Moreover, as a solid electrolyte used for a solid electrolytic capacitor, although the manganese dioxide and 7, 7, 8, and 8-tetracyano quinodimethan (TCNQ) complex are known, a rate of reaction is loose and the technique (JP,2-15611,A) which paid its attention to polyethylene dioxythiophene (it is hereafter described as PEDT) excellent in adhesion with the oxide-film layer of an anode plate electrode exists in recent years.
[0005] the solid electrolytic capacitor which has such a solid electrolyte layer -- formation -- it is produced by production process called -> component formation -> solid electrolyte stratification -> resin seal -> aging. Below, the production process of the solid electrolytic capacitor of the type which forms the solid electrolyte layer which becomes the capacitor element of a winding mold from polyethylene dioxythiophene as an example of such a solid-state electrolytic capacitor is explained briefly.
[0006] First, after carrying out surface roughening to the front face of the anode plate foil which consists of valve action metals, such as aluminum, by electrochemical etching processing in a chloride water solution and forming many etching pits in it, the oxide film layer which impresses an electrical potential difference in water solutions, such as ammonium pentaborate, and serves as a dielectric is formed (formation). Like this anode plate foil, although a cathode foil also consists of valve action metals, such as aluminum, it is only performing etching processing to that front face. Moreover, the electrode drawer means for connecting each electrode outside is connected to an anode plate foil and a cathode foil with

well-known means, such as a stitch and ultrasonic welding.
[0007] Next, the anode plate foil and cathode foil with which the oxide-film layer was formed in the front face as mentioned above are wound through a separator, and a capacitor element is formed (component formation). And ethylene dioxythiophene (it is hereafter described as EDT) and an oxidizing agent are sunk in and heated to this capacitor element, and the solid electrolyte layer which consists of polyethylene dioxythiophene (PEDT) between two electrodes is formed (solid electrolyte stratification).
[0008] Then, sheathing resin is covered on the periphery of a capacitor element by adhering and carrying out heat curing of the thermosetting resin of the epoxy resin system which used the curing agent of an acid-anhydride system on the surface of a capacitor element. And it inserts in the through tube in which said electrode drawer means was formed by obturation rubber, a cylinder-like-object-with-base-like sheathing case is equipped with a capacitor element, opening of a sheathing case is obturated with said obturation rubber, and a solid electrolytic capacitor is created.
[0009]
[Problem(s) to be Solved by the Invention] However, since a property deteriorated in elevated-temperature life test exceeding 105 degrees C when elevated-temperature life test is performed about the solid electrolytic capacitor using the epoxy resin using the curing agent of an acid-anhydride system as a sealing agent, using PEDT as a solid electrolyte which was mentioned above, 105 degrees C of maximum service temperature were a limitation.
[0010] Thus, it is considered to be based on the following reasons that a property deteriorates in elevated-temperature life test exceeding 105 degrees C in the solid electrolytic capacitor using the epoxy resin using the curing agent of an acid-anhydride system as a sealing agent, using PEDT as a solid electrolyte. That is, since a certain amount of [at the process although there is a property in which the epoxy resin using the acid-anhydride system curing agent used from the former as sheathing resin which covers the periphery of a capacitor element absorbs moisture in a hardening process, before sinking in this resin and making it harden] moisture to a capacitor element adsorbs, even if the moisture in a capacitor element is absorbed by this resin in a hardening process, in a capacitor element, moisture still remains. Therefore, in the temperature of 105 degrees C or less, it is thought that the engine performance of an oxide film is kept good by this moisture that remained, and initial properties, such as a withstand voltage property and a leakage current property, are kept good. However, in an elevated temperature 105 degrees C or more, in order that the moisture which remained in the capacitor element may work to hydration degradation of an oxide film and the electric conductivity fall of PEDT, it is thought that a property deteriorates.
[0011] It is proposed in order that this invention may solve the trouble of the conventional technique which was mentioned above, and the purpose uses PEDT as an electrolyte, and it is in maximum service temperature offering a solid electrolytic capacitor and its manufacture approach 105 degrees C or more.
[0012]
[Means for Solving the Problem] this invention person used to come to complete this invention, as a result of repeating examination wholeheartedly about the solid electrolytic capacitor which can enable the rise of maximum service temperature, and its manufacture approach that the above-mentioned technical problem should be solved. That is, when the moisture which remains in a capacitor element was removed to some extent in 130-degree C life test, this invention person thought that degradation of a property could be controlled, dried the capacitor element at the process before sinking in and hardening resin, and after removing the moisture with which resin is adsorbed to some extent, he examined sealing agents other than an epoxy resin. Consequently, it becomes clear that effectiveness is in a silicon system sealing agent. In addition, as this silicon system sealing agent, it is desirable to use silicon resin and a silicone oil, and the heat-curing temperature of a silicon system sealing agent has desirable 15-150 degrees C.
[0013] Moreover, as an approach of drying a capacitor element, if the approach of leaving a capacitor element in a thermostat, the approach of applying hot blast to a capacitor element, the method of leaving a capacitor element in a reduced pressure tub, etc. can remove the moisture in a capacitor element, they

can apply various approaches. In addition, 5 - 30 minutes of drying temperature are [15-120 degrees C and the drying time] desirable.
[0014] Moreover, it is considered to be based on the following reasons that good effectiveness was acquired with the silicon system sealing agent. That is, even if it dries the capacitor element which formed the PEDT layer as an electrolyte layer, the moisture in a capacitor element is not necessarily removed completely, and the moisture of water-of-crystallization level remains. However, since a silicon system sealing agent does not absorb moisture during resin hardening, it is thought that the engine performance of an oxide film is kept good by the moisture of this water-of-crystallization level that remained, and initial properties, such as a withstand voltage property and a leakage current property, are kept good. On the other hand, since this moisture works neither to hydration degradation of an oxide film nor the electric conductivity fall of PEDT and a property does not necessarily deteriorate in 130-degree C elevated-temperature life test even if moisture of this level remains, it is thought that a property is kept good.
[0015]
[Example] Hereafter, based on an example, this invention is further explained to a detail.
[0016] The solid electrolytic capacitor concerning this invention was created like the following examples. Moreover, the solid electrolytic capacitor closed with the epoxy resin using an acid-anhydride system curing agent was used before the resin seal as a conventional example, without drying a capacitor element. Furthermore, as an example 1 of a comparison, after drying a capacitor element before a resin seal, the solid electrolytic capacitor closed with silicon resin was used as an example 2 of a comparison using the solid electrolytic capacitor closed with the epoxy resin using an acid-anhydride system curing agent, without drying a capacitor element before a resin seal.
[0017] (Example) The anode plate foil and cathode foil with which the oxide-film layer was formed in the front face are wound through a separator, and a capacitor element is formed. And the EDT monomer was sunk into this capacitor element, further, it sank in, 100 degrees C of butanol solutions of 45% of the second iron of Para toluenesulfonic acid were heated as an oxidizing agent solution, for 1 hour, and the solid electrolyte layer which consists of PEDT was generated. And after leaving this capacitor element in the 100-degree C thermostat for 20 minutes and drying, sheathing resin was covered on the periphery of a capacitor element by adhering to the front face of a capacitor element and making it carry out heat curing (100 degrees C, 1 hour) of the silicon resin. And it inserted in the through tube in which the electrode drawer means was formed by obturation rubber, the cylinder-like-object-with-base-like aluminum case was equipped with the capacitor element, opening of a sheathing case was obturated with said obturation rubber, and the solid electrolytic capacitor was created.
[0018] (Conventional example) The solid electrolytic capacitor was formed according to the conventional technique which mentioned above the acid-anhydride system curing agent as sheathing resin of a capacitor element using the epoxy resin added 50%. That is, before the resin seal, without drying a capacitor element, it closed with the epoxy resin using an acid-anhydride system curing agent, and the solid electrolytic capacitor was formed.
[0019] (Example 1 of a comparison) As sheathing resin of a capacitor element, the solid electrolytic capacitor was formed by the same approach as the conventional example and the example mentioned above using the epoxy resin using the same acid-anhydride system curing agent. That is, after drying a capacitor element before a resin seal, the epoxy resin using an acid-anhydride system curing agent performed the resin seal.
[0020] (Example 2 of a comparison) As sheathing resin of a capacitor element, the solid electrolytic capacitor was formed according to the conventional technique mentioned above using the same silicon resin as an example. That is, silicon resin performed the resin seal, without drying a capacitor element before a resin seal.
[0021] [Comparison result] About the solid electrolytic capacitor of the example acquired by the above-mentioned approach, the conventional example, the example 1 of a comparison, and the example 2 of a comparison, when the shelf test of 1000 hours was performed at 130 degrees C, the result as shown in the next table 1 was obtained.

[0022]
[Table 1]

	封止材	初期特性			130℃−1000時間		
		Cap (μF)	tanδ	ESR(Ω)	ΔCap (%)	tanδ	ESR(Ω)
実施例	シリコン樹脂 (乾燥処理あり)	7.1	0.020	0.059	−3.6	0.019	0.072
従来例	酸無水物系硬化剤を用いたエポキシ樹脂 (乾燥処理なし)	7.0	0.021	0.070	−4.0	0.025	0.110
比較例1	酸無水物系硬化剤を用いたエポキシ樹脂 (乾燥処理あり)	7.5	0.020	0.060	—	—	—
比較例2	シリコン樹脂 (乾燥処理なし)	7.2	0.019	0.060	−3.8	0.019	0.120

[0023] When it was left at 130 degrees C for 1000 hours so that clearly from Table 1, in the conventional example, Cap decreased 4% as compared with initial value, and tandelta went up by about 1.25 times the initial value. Moreover, equivalent series resistance (ESR) rose by about 1.6 times the initial value. On the other hand, in the example, Cap and tandelta of the initial property were almost equal to the conventional example, and ESR was about 84.3% of the conventional example. Moreover, although Cap decreased 3.6% as compared with initial value when it was left at 130 degrees C for 1000 hours, as for tandelta, the value almost equal to initial value was shown, and ESR went up by about 1.2 times the initial value.
[0024] Thus, in the example using silicon resin as a sealing agent, even if it dried the capacitor element in which the PEDT layer was formed, before the resin seal, the same initial property as the conventional example could be acquired, and further, even if it used it at the 130-degree C elevated temperature, it became clear that the property did not deteriorate. Since the moisture of the minute amount which remained is not absorbed with silicon resin even if the reason dries the capacitor element in which the PEDT layer was formed, before a resin seal in the example which used silicon resin as a sealing agent, it is thought that moisture required to maintain an initial property remains. Moreover, although the good result was obtained also in elevated-temperature life test, since the reason has removed the moisture adhering to a capacitor element by desiccation before a resin seal in an example, although moisture required to maintain an initial property remains, it is thought that it is for not doing a bad influence in a 130-degree C elevated temperature since too much moisture is removed.
[0025] moreover, the example 1 of a comparison which dried the capacitor element before the resin seal and was closed with the epoxy resin using an acid-anhydride system curing agent -- setting -- early Cap and tan -- delta and ESR both showed the value almost equal to the conventional example and an example. Moreover, although not shown in Table 1, in the example 1 of a comparison, the early leakage current (LC) became very large with "300", and the value which separated from specification greatly was shown. Therefore, elevated-temperature life test was not carried out about the example 1 of a comparison.
[0026] Thus, it is considered to be based on the following reasons that the initial property became what separated from specification in the example 1 of a comparison. That is, as a result of drying the capacitor element in which the PEDT layer was formed, before a resin seal, only the moisture of a minute amount remains in the capacitor element. If the epoxy resin using an acid-anhydride system curing agent performs a resin seal in this condition, since the moisture of the minute amount which remained in the

capacitor element in that hardening process will be absorbed further, an initial property is considered to have fallen sharply.
[0027] furthermore, the example 2 of a comparison which performed the resin seal with silicon resin, without drying a capacitor element -- setting -- the initial property -- Cap and tan -- delta and ESR became almost equal to the conventional example and an example. Moreover, although Cap decreased about 3.8% as compared with initial value when it was left at 130 degrees C for 1000 hours, as for tandelta, the value almost equal to initial value was shown. However, ESR went up the twice of initial value. Consequently, when it was left at 130 degrees C for 1000 hours, ESR became about 1.7 times compared with the example, and even if compared with the conventional example, one about 1.1 times the value of this was shown, and the property fell from the conventional example. It became clear that the outstanding elevated-temperature property was not acquired from this unless it dries a capacitor element before a resin seal, even if it is the case where silicon resin is used as a sealing agent.
[0028] In the example 2 of a comparison, it is considered to be based on the following reasons that such a result was obtained. That is, when not drying a capacitor element before a resin seal, a capacitor element will absorb moisture at the process in front of a resin seal, and a certain amount of moisture will be included in a component. It is thought that ESR deteriorates in order that this moisture may work to hydration degradation of an oxide film etc. during elevated-temperature life test.
[0029] From the above thing, according to the example which is this invention article, compared with the conventional example, an elevated-temperature life property can improve sharply, and the solid electrolytic capacitor of 130-degree-C specification can be realized.
[0030]
[Effect of the Invention] As explained above, after drying the capacitor element in which the PEDT layer was formed, before a resin seal according to this invention, maximum service temperature can offer a solid electrolytic capacitor and its manufacture approach 105 degrees C or more by forming in the front face of a capacitor element the layer which consists of a silicon sealing agent.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to a solid electrolytic capacitor and its manufacture approach, and relates to the solid electrolytic capacitor which improved in order to aim at improvement in an elevated-temperature life property especially, and its manufacture approach.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] Generally the electrolytic capacitor using the metal which has valve action, such as a tantalum or aluminum, is widely used from the ability of a small and big capacity to be obtained by making the valve action metal as an anode plate side counterelectrode into the configuration of a sintered compact or an etching foil, and surface-expansion-izing a dielectric. In addition to being small, large capacity, and low equivalent series resistance, itis [chip-] easy toize especially the solid electrolytic capacitor that used the solid electrolyte for the electrolyte, and since it is equipped with special features, such as being suitable for the surface mount, it is indispensable to the miniaturization of electronic equipment, advanced features, and low cost-ization.
[0003] In this kind of solid electrolytic capacitor, as small and a mass application, a separator is made to intervene, generally, the anode plate foil and cathode foil which consist of valve action metals, such as aluminum, are wound, a capacitor element is formed, the electrolytic solution for a drive is sunk into this capacitor element, and it has the structure which contained and sealed the capacitor element in metal cases, such as aluminum, or the case made of synthetic resin. In addition, as an anode material, a tantalum, niobium, titanium, etc. are used by making aluminum into the start, and an anode material and a metal of the same kind are used for a cathode material.
[0004] Moreover, as a solid electrolyte used for a solid electrolytic capacitor, although the manganese dioxide and 7, 7, 8, and 8-tetracyano quinodimethan (TCNQ) complex are known, a rate of reaction is loose and the technique (JP,2-15611,A) which paid its attention to polyethylene dioxythiophene (it is hereafter described as PEDT) excellent in adhesion with the oxide-film layer of an anode plate electrode exists in recent years.
[0005] the solid electrolytic capacitor which has such a solid electrolyte layer -- formation -- it is produced by production process called -> component formation -> solid electrolyte stratification -> resin seal -> aging. Below, the production process of the solid electrolytic capacitor of the type which forms the solid electrolyte layer which becomes the capacitor element of a winding mold from polyethylene dioxythiophene as an example of such a solid-state electrolytic capacitor is explained briefly.
[0006] First, after carrying out surface roughening to the front face of the anode plate foil which consists of valve action metals, such as aluminum, by electrochemical etching processing in a chloride water solution and forming many etching pits in it, the oxide film layer which impresses an electrical potential difference in water solutions, such as ammonium pentaborate, and serves as a dielectric is formed (formation). Like this anode plate foil, although a cathode foil also consists of valve action metals, such as aluminum, it is only performing etching processing to that front face. Moreover, the electrode drawer means for connecting each electrode outside is connected to an anode plate foil and a cathode foil with well-known means, such as a stitch and ultrasonic welding.
[0007] Next, the anode plate foil and cathode foil with which the oxide-film layer was formed in the front face as mentioned above are wound through a separator, and a capacitor element is formed (component formation). And ethylene dioxythiophene (it is hereafter described as EDT) and an oxidizing agent are sunk in and heated to this capacitor element, and the solid electrolyte layer which consists of polyethylene dioxythiophene (PEDT) between two electrodes is formed (solid electrolyte

stratification).

[0008] Then, sheathing resin is covered on the periphery of a capacitor element by adhering and carrying out heat curing of the thermosetting resin of the epoxy resin system which used the curing agent of an acid-anhydride system on the surface of a capacitor element. And it inserts in the through tube in which said electrode drawer means was formed by obturation rubber, a cylinder-like-object-with-base-like sheathing case is equipped with a capacitor element, opening of a sheathing case is obturated with said obturation rubber, and a solid electrolytic capacitor is created.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, after drying the capacitor element in which the PEDT layer was formed, before a resin seal according to this invention, maximum service temperature can offer a solid electrolytic capacitor and its manufacture approach 105 degrees C or more by forming in the front face of a capacitor element the layer which consists of a silicon sealing agent.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, since a property deteriorated in elevated-temperature life test exceeding 105 degrees C when elevated-temperature life test is performed about the solid electrolytic capacitor using the epoxy resin using the curing agent of an acid-anhydride system as a sealing agent, using PEDT as a solid electrolyte which was mentioned above, 105 degrees C of maximum service temperature were a limitation.
[0010] Thus, it is considered to be based on the following reasons that a property deteriorates in elevated-temperature life test exceeding 105 degrees C in the solid electrolytic capacitor using the epoxy resin using the curing agent of an acid-anhydride system as a sealing agent, using PEDT as a solid electrolyte. That is, since a certain amount of [at the process although there is a property in which the epoxy resin using the acid-anhydride system curing agent used from the former as sheathing resin which covers the periphery of a capacitor element absorbs moisture in a hardening process, before sinking in this resin and making it harden] moisture to a capacitor element adsorbs, even if the moisture in a capacitor element is absorbed by this resin in a hardening process, in a capacitor element, moisture still remains. Therefore, in the temperature of 105 degrees C or less, it is thought that the engine performance of an oxide film is kept good by this moisture that remained, and initial properties, such as a withstand voltage property and a leakage current property, are kept good. However, in an elevated temperature 105 degrees C or more, in order that the moisture which remained in the capacitor element may work to hydration degradation of an oxide film and the electric conductivity fall of PEDT, it is thought that a property deteriorates.
[0011] It is proposed in order that this invention may solve the trouble of the conventional technique which was mentioned above, and the purpose uses PEDT as an electrolyte, and it is in maximum service temperature offering a solid electrolytic capacitor and its manufacture approach 105 degrees C or more.

[Translation done.]

MEANS

[Means for Solving the Problem] this invention person used to come to complete this invention, as a result of repeating examination wholeheartedly about the solid electrolytic capacitor which can enable the rise of maximum service temperature, and its manufacture approach that the above-mentioned technical problem should be solved. That is, when the moisture which remains in a capacitor element was removed to some extent in 130-degree C life test, this invention person thought that degradation of a property could be controlled, dried the capacitor element at the process before sinking in and hardening resin, and after removing the moisture with which resin is adsorbed to some extent, he examined sealing agents other than an epoxy resin. Consequently, it becomes clear that effectiveness is in a silicon system sealing agent. In addition, as this silicon system sealing agent, it is desirable to use silicon resin and a silicone oil, and the heat-curing temperature of a silicon system sealing agent has desirable 15-150 degrees C.
[0013] Moreover, as an approach of drying a capacitor element, if the approach of leaving a capacitor element in a thermostat, the approach of applying hot blast to a capacitor element, the method of leaving a capacitor element in a reduced pressure tub, etc. can remove the moisture in a capacitor element, they can apply various approaches. In addition, 5 - 30 minutes of drying temperature are [15-120 degrees C and the drying time] desirable.
[0014] Moreover, it is considered to be based on the following reasons that good effectiveness was acquired with the silicon system sealing agent. That is, even if it dries the capacitor element which formed the PEDT layer as an electrolyte layer, the moisture in a capacitor element is not necessarily removed completely, and the moisture of water-of-crystallization level remains. However, since a silicon system sealing agent does not absorb moisture during resin hardening, it is thought that the engine performance of an oxide film is kept good by the moisture of this water-of-crystallization level that remained, and initial properties, such as a withstand voltage property and a leakage current property, are kept good. On the other hand, since this moisture works neither to hydration degradation of an oxide film nor the electric conductivity fall of PEDT and a property does not necessarily deteriorate in 130-degree C elevated-temperature life test even if moisture of this level remains, it is thought that a property is kept good.

[Translation done.]

EXAMPLE

[Example] Hereafter, based on an example, this invention is further explained to a detail.
[0016] The solid electrolytic capacitor concerning this invention was created like the following examples. Moreover, the solid electrolytic capacitor closed with the epoxy resin using an acid-anhydride system curing agent was used before the resin seal as a conventional example, without drying a capacitor element. Furthermore, as an example 1 of a comparison, after drying a capacitor element before a resin seal, the solid electrolytic capacitor closed with silicon resin was used as an example 2 of a comparison using the solid electrolytic capacitor closed with the epoxy resin using an acid-anhydride system curing agent, without drying a capacitor element before a resin seal.

[Translation done.]